Organised by

malaysiaGBC

Established Member of

WORLD GREEN BUILDING COUNCIL

SUSTAINABLE DEVELOPMENT GOALS

NATURAL RESOURCES:

WATER EFFICIENCY FOR SUSTAINABLE LIVING

13 AUGUST 2022 | VIRTUAL VIA ZOOM

Integrated Urban Water Management Towards Sustainable Cities

- a sharing by Ir. C Kamalesen

26 March 2022

Presentation Outline

- Introduction
- Defining IUWM
- Key Issues
- Why IUWM?
- How IUWM Can Be Achieved?
- Example of IUWM and Sustainable Cities
- Conclusion
- Acknowledgement

INTRODUCTION

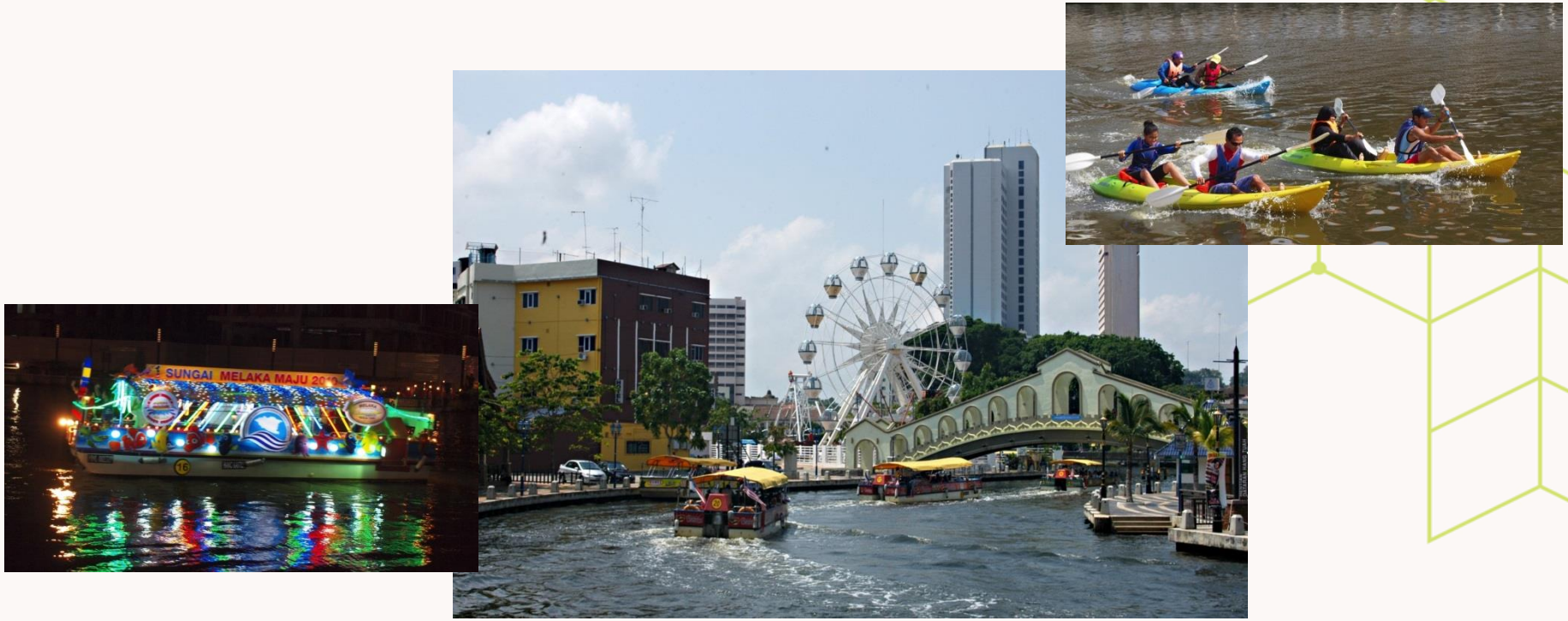
Introduction

– Our cities, towns and villages all have a long and intimate relationship with water and were historically located around a water source, watercourse or coastline as the focus point for life and trade.

Source: Perbadanan Pengurusan Sungai dan Pantai Melaka (PPSPM)

Introduction

– In modern times, not only do we depend on clean water supply for our daily needs, but we also depend on water to grow our food and produce resources, to transport our goods and waste, beautify our urban areas and provide fun and recreation.



Source: PPSPM

Introduction

– It is undeniable that the relationship between water and our urban areas needs to be given a higher priority to provide integrated solutions to flood risk management, sustainable water use and supply and the improvement of water quality in our treasured watercourses.

GOAL

EXAMINE THE INTERCONNECTION OF THE URBAN WATER COMPONENTS AND THE POTENTIAL ALTERNATIVES OF BASIN AND CITY MANAGEMENT WHICH USUALLY DO NOT SHARE THE SAME INSTITUTIONAL SPACE.

OBJECTIVES

EXPLORE THE INTERFACE OF THE URBAN WATER SYSTEMS IN THE CONTEXT OF ACTUAL MANAGEMENT. DESCRIBE THE POTENTIAL INSTITUTIONAL ARRANGEMENT OF BASIN IWRM WITH URBAN WATER MANAGEMENT.

DEFINING IUWM

Defining IUWM

– **Integrated Urban Water Management**:

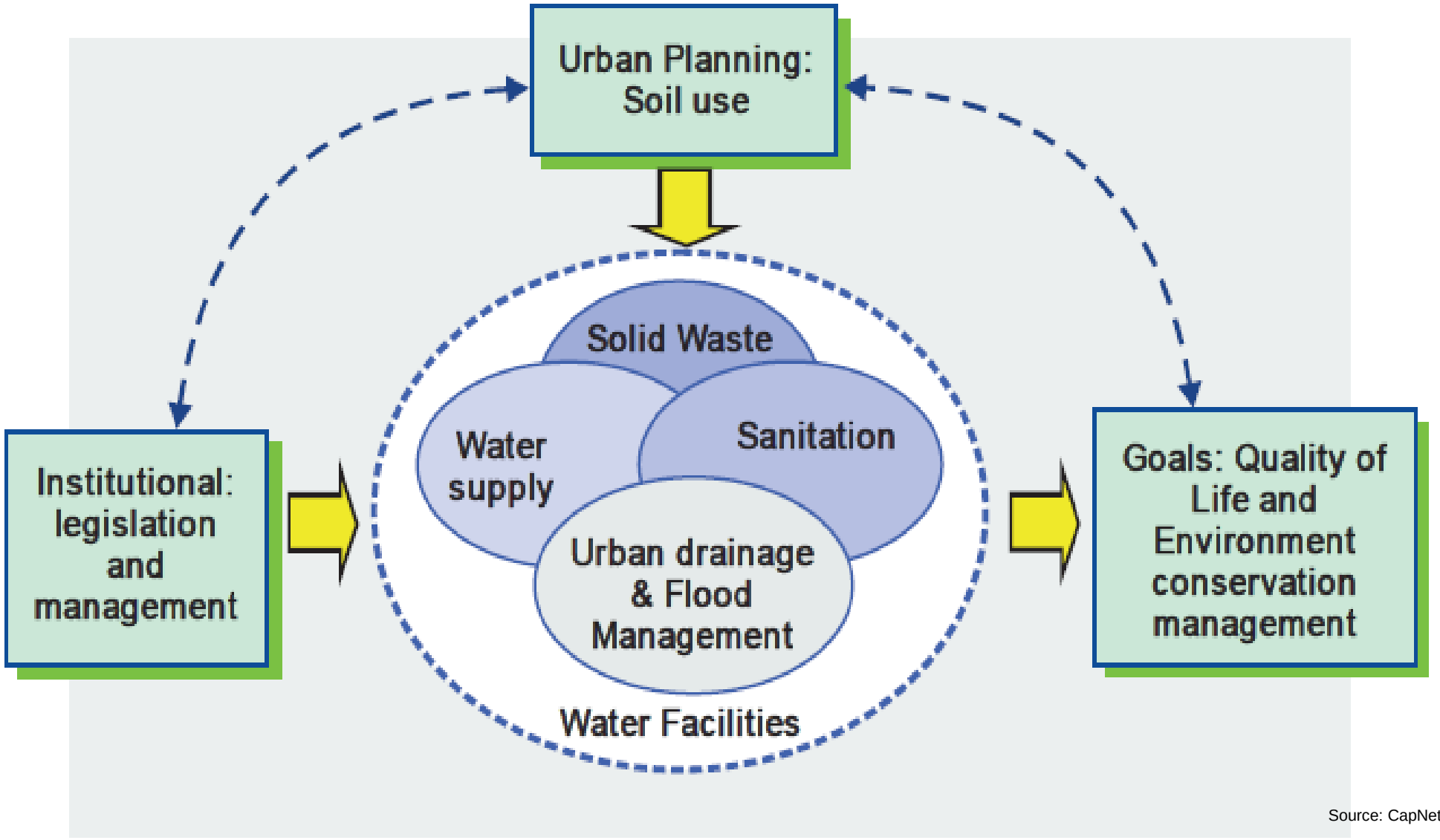
"A holistic mode of strategic planning which takes a landscape view of water challenges by looking at competing water users in an urban area, catchment or river basin.

Implementation:

"Through coordinated and flexible planning among water using sectors, allowing for optimal sequencing of traditional and new infrastructure with alternative management scenarios that leverage on efficiencies and conservation."

Source: World Bank

Defining IUWM



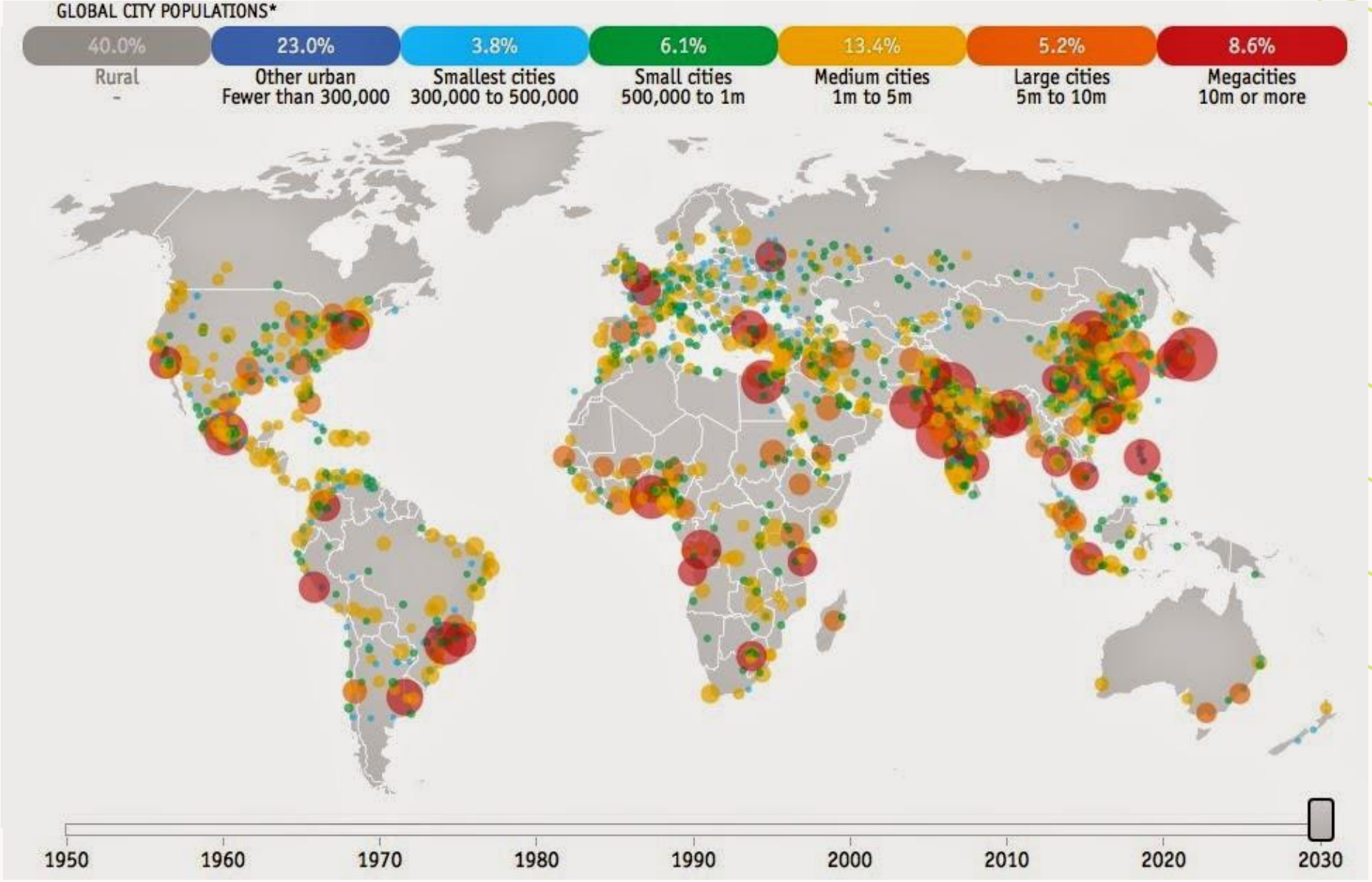
Source: CapNet

Service Objectives

- Urban development – land use must preserve natural conditions and enable the system to support transportation, water supply, sanitation & effluent treatment, urban drainage and solid waste collection & disposal;
- Water supply must be provided from reliable, uncontaminated sources;
- Excess sewage must be treated – no contamination of the water supply;
- Urban drainage – preserve natural infiltration; avoid transferring downstream increased flow and contaminant load from stormwater runoff and soil erosion; and
- Solid waste must be recycled to encourage sustainability, financial exploitation of this resource, and proper disposal of the remaining material.

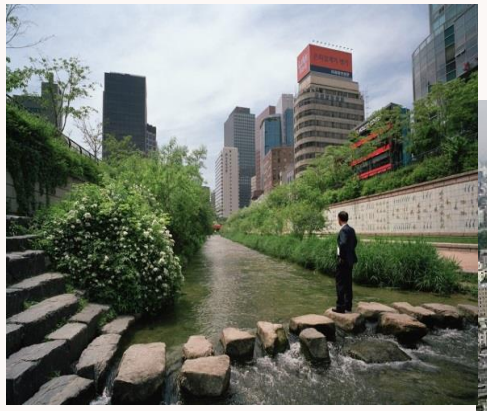
KEY ISSUES

Urbanization and Rise of the Cities (1950 – 2030)

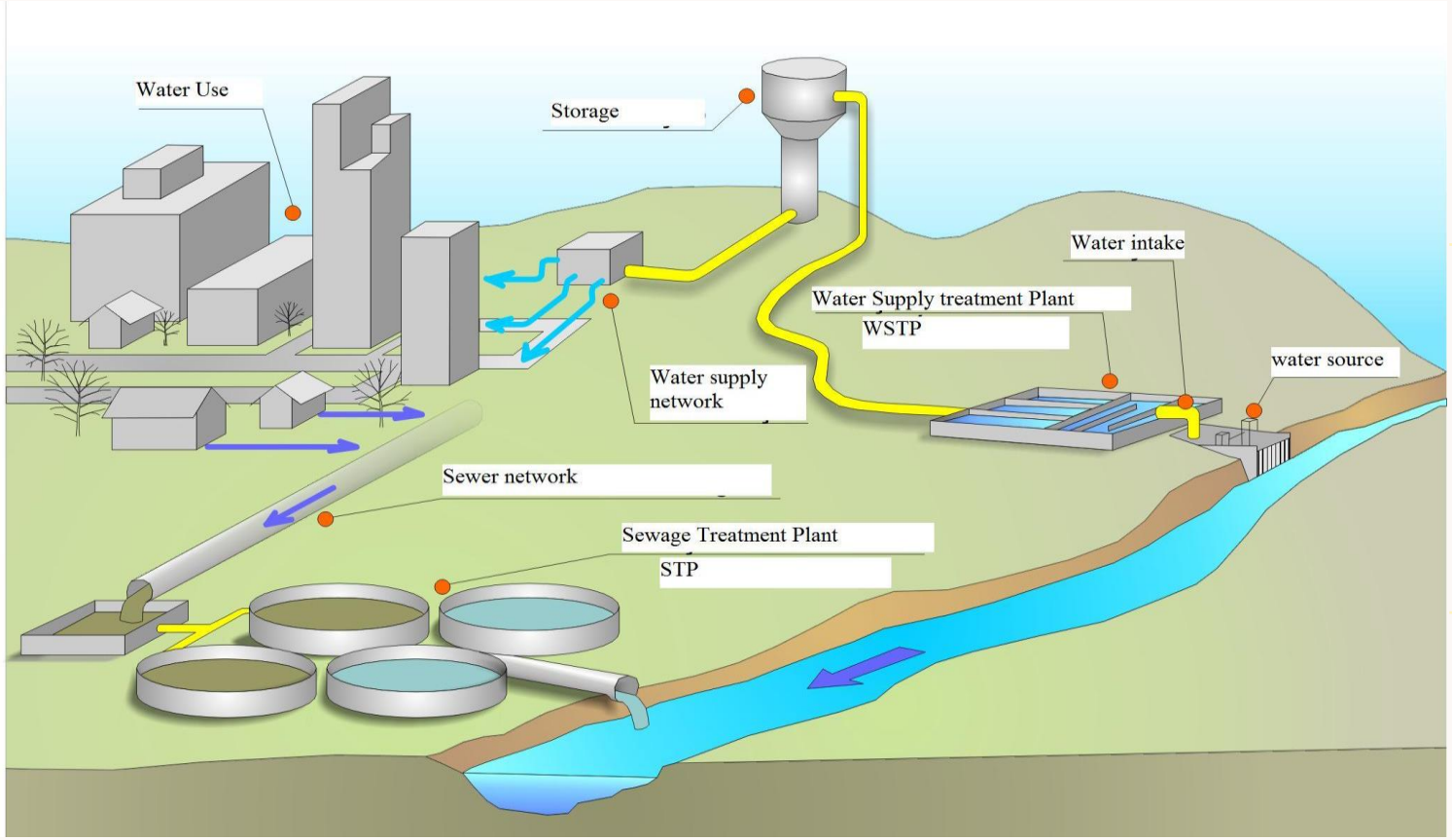


Urban River Basin Issues

1. **Total Population: 29 million (2010 Census); 42 million in 2050**
2. **Percentage of urban population: 71% in 2012; 80% in 2050**
3. **Rapid growth incongruent with provisions in Landuse Plan**
4. **<u>Result</u>: Urban areas face higher and magnified risk of water shortages, localized floods, droughts and water pollution**



Urban River Basin Issues

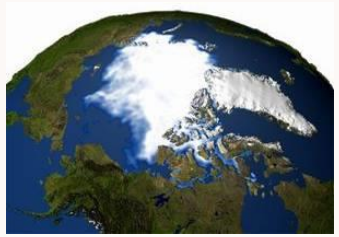


Fragmented planning & design of urban water services & infrastructure;

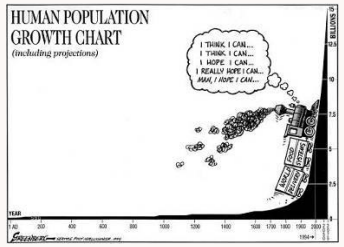
Public health problems, frequent flooding, and the loss of a rich, diversified environment in many regions; and

Transformation from a rural to an urban environment – a growing legacy of loss and liability for future generations.

Urban Environmental Challenges



Climate change,
climate variability



Demographic pressure:
population growth

Urbanization and
settling on floodplains

There is no absolute
safety.

Decision making processes
- Community Participation,
multi-stakeholder
involvement

Ecosystem
conservation

Securing livelihoods

Emergency response
and Early-Warnings

Kemarau punca loji kering

DARI MUKA 1

BH 26/3/98

alternatif bagi mengatasi masalah bekalan air di Lembah Klang. Kajian itu kini di peringkat akhir dan akan diumumkan sebaik saja siap.

Penolong Pengarah Kananya, V Subramanian, berkata JBA kini menghadapi masalah untuk membekalkan air kepada pengguna di sekitar Lembah Klang kerana musim kemarau.

"Musim kemarau yang melanda di sektar Lembah Klang menyebabkan loji kekeringan dan beberapa tempat di sekitar Lembah Klang terputus bekalan air.

"Loji Hulu Langat dan Cheras tidak mampu membekalkan air di kawasan tanah tinggi dan sekitarnya kerana pengeluarannya berkurangan 40 peratus akibat kemarau," katanya ketika dihubungi.

Dalam perkembangan berkaitan, bekalan air ke beberapa kawasan di Lembah Klang sekali lagi terganggu apabila loji rawatan air Batu 11 Cheras ditutup hari ini bagi kali keenam sejak Januari berikutan kandungan tinggi ammonia dalam air mentah yang mengalir dari Sungai Langat.

Puncak Niaga (M) Sdn Bhd, syarikat yang mengendalikan loji itu, berkata musim kering sekarang menyebabkan paras air Sungai Langat menurun dan air mentah itu tidak mencukupi untuk melarutkan ammonia melalui proses semula jadi.

Masalah air semakin kritikal

BH 26/3/98

SABAR... dengan menggunakan baldi dan pelbagai jenis bekas lain, penduduk Taman Setiawangsa di Ibu kota yan bekalan yang Gombak.

Sehingga Kuala Lumpu ngat kritikal sebahagian

Keadaan itu menyebabkan paras air di sungai yang membekalkan air mentah ke loji penapisan

RSDAY, FEBRUARY 24, 2005

TION

PAGE 25

worst dry spell in living memory

■ By Sheridan Mahavera
mahavera@nst.com.my

ALOR STAR, Wed. — The current dry spell in Kedah, which is causing bush and field fires, has been described by some as the worst in living memory.

The lakes and dams essential to the State's rice industry are also fast drying up.

The Pedu, Ahning and Muda dams in the interior of the State report water levels that are 10 per cent lower than in previous years.

Resorts surrounding the man-made Pedu Lake have cancelled water sports activities, such as canoeing and jet skiing as receding water levels have exposed the lake's underwater trees.

Mutiara Pedu Lake Resort business development manager Wan Fauziah Wan Mamat said the dry season this year had hit the resort's business.

"We had to reorganise our activities for our guests by offering inland activities such as jungle trekking since the water level at the lake has made it too dangerous for water sports.

"Last year was not as bad as this year.

"Three months ago, it was worse as water levels dropped to 95.3 metres from the optimum level of 106.7 metres," she said.

Fire and Rescue Departments in the State are on high alert until next month as the dry season has sparked off numerous bush and field fires in the padi planting areas of Kota Star, Pendang and Yan.

State Fire and Rescue Department chief Mohd Yunos Abu Hassan said stations received an average of nine to 10 calls per day starting from last month.

"Compared with the same period last year, we have recorded a hike in bush fires.

"The most critical are the padi fields which flank the North-South Expressway as smoke from the fires can envelop the highway and cause accidents," Mohd Yunos said.

Fires, he said, were not just caused by discarded cigarette butts but also spontaneous combustion of dry fields when high temperatures caused twigs, shrubs and stalks to reach their flashpoint.

Agriculture authorities have been monitoring falling water levels in the three dams, but are confident that there is enough water for the next padi planting season in April.

Muda Agricultural Development Authority general manager Datuk Abdul Rahim Salleh said there was enough water to meet the State's domestic and industrial needs.

"God willing we will have enough water for the 96,000 hectares of padi fields under us.

"This is because the dams only supply 30 per cent of their water.

"The rest is from rainfall and other sources," Abdul Rahim said.

If the situation worsens, he added, farmers would have to practise dry seeding in the next season.

Meanwhile, residents and those working in the hot sun have resorted to various measures to keep themselves cool in the wake of the heat.

Trishaw rider Mustapha Man, 56, has taken to having occasional dips in a fountain along the Lebuhraya Darulaman to cool off after his trips.

"I come to the fountain to wash my head and face usually in the late afternoon before Asar prayers at the Zahir mosque.

"I sometimes come twice a day to cool off. I can't remember when it was this hot," he said when met at the fountain.

ky Garden,

MANAGEMENT" (INNOBP-Urban)

vent, Exhibition • 8 - 9 March: Conference, Exhibition

S/CASE STUDIES:

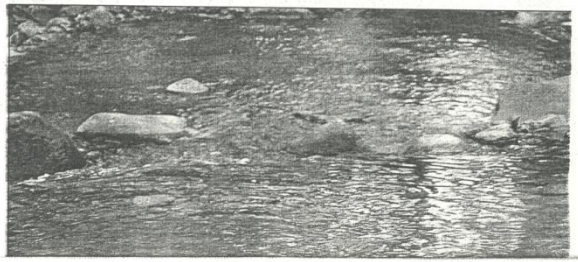
CONFIRMED SPEAKERS

on Creates Spin-off Benefits to
ment from Government-
Partnership

neurs via Collaborative Efforts
ss Community and the

Ms. Olivia Loughnane
Director of Research & Development, Shannon Development, Ireland

Professor Sven E O Hort
Research Director Urban Development Evaluation Project , Södertörn University College, Sweden



KERING-KONTANG...Lebih 6,000 petani di Perlis kini imbang kemungkinan hilang mata pencarian apabila bendang ereka kering-kontang kerana air tidak dapat disalurkan ke awah.

Jabatan Pengairan dan Saliran (JPS) negeri itu tidak dapat erbuat demikian kerana paras air di Empangan Timah Tasoh erus susut kepada 27.02 meter semalam.

Akibatnya, para petani yang sepatutnya memulakan tanaman padi dalam masa beberapa hari lagi tidak dapat mengerjakan sawah mereka.

Ia merupakan kali kedua bekalan air untuk pertanian di negeri itu terpaksa dihentikan. Sebelum ini ialah pada 1998 ekoran fenomena El-Nino.

● SALLEH Abu Bakar menunjukkan keadaan sawahnya kering-kontang akibat kemarau panjang yang menyebabkan penanaman padi tidak dapat dilakukan di Kampung Teluk Jambu Bintong, Kangar, Perlis, semalam. — Gambar NIDZUWAN ZAINAL ABIDIN

10 Prime News

NEW STRAITS TIMES MONDAY, MAY 9, 2005

Villagers turn to rivers for supply

FRESH SUPPLY: Felcra Bukit Tandak worker Rizwan Abdul Rani using a tractor to transport water twice a day from Bukit Kwong dam in Lubok Stol to Bukit Tandak. — Bernama picture

RANTAU PANJANG, Sun. — A drought that has lingered from the beginning of this year has forced people in at least 10 villages in the Gual Periok state constituency to use water from swamps and rivers for their daily needs.

A check revealed that the wells in the villages, located on high ground, had dried up and the piped water supplied by Air Kelantan Sdn Bhd (AKSB) is sufficient for only a small number of the 30,000 people in the constituency.

The AKSB provided water up to Kampung Kubang Kual and is unable to channel water to Kampung Tasek Gondang, some 1.8km away, according to Abdul Rahim Che Wil, 56, who lives in Tasek Gondang.

"As a result, we are forced to use well water as our main source of supply, and have to spend RM30 a month to buy clean water for drinking and cooking," he said.

"We also have to use the dirty water from nearby rivers for bathing and washing clothes, which has resulted in some of the people suffering from itchiness of the skin," he added.

Abdul Rahim said the people in the village also forked out money to buy a RM120 pump to channel water from a mangrove swamp.

Gual Periok State Assemblyman Datuk Shaari Mat Hussain said the Federal Government had provided 48-metre deep tube wells in 13 villages in the constituency.

"Nevertheless, the tube wells are unable to meet the needs of the 30,000 people," he said. — Bernama

Water Supply (Prolonged Dry Spell)

Item	Year	State	Remarks
1.	1990	Melaka, Johor	Melaka water crisis (Durian Tunggal Dam)
2.	1998	Kuala Lumpur, Selangor, Pulau Pinang, Melaka, Kedah, Kelantan, Sabah & Sarawak	El-Nino
3.	2005	Negeri Sembilan	Negeri Sembilan water crisis
4.	2010	Sabah, Johor, Kedah, Perlis	El-Nino
5.	2014	Kuala Lumpur, Selangor, Johor, Kelantan, Perak	Prolonged dry spell
6.	2016	Perlis, Kedah, Pulau Pinang, Johor, Perak, Kelantan	El-Nino

Source: Jabatan Pengairan dan Saliran Malaysia (JPS)


NASIONAL
Banjir di Perlis luar biasa
Satu pertiga kawasan dinaiki air 0.5 meter hingga 2.5 meter
ISTANA ARAU


BERITA HARIAN
Lebih 16,000 mangsa dipindah
Banjir di Kedah, Perlis dan Perak bertambah buruk, dua lemas di Pantai Timur

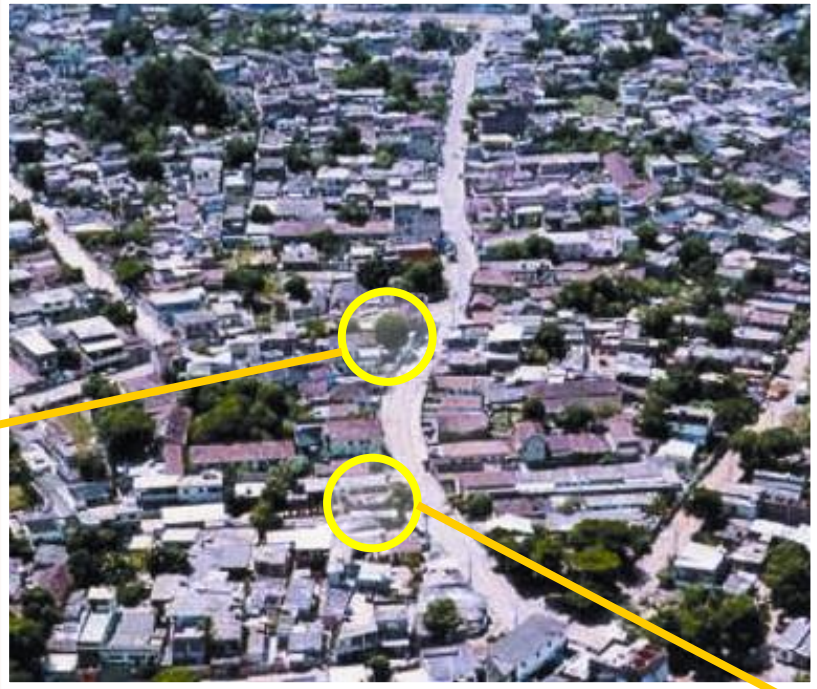

Paling buruk dalam tempoh 10 tahun ● 1,240 penduduk dipindah
Shah Alam banjir besar
DITENGGELAMI AIR... Beginilah keadaan di beberapa kawasan termasuk sekitar Stadium Shah Alam, Selangor yang dilanda banjir kilat ekoran hujan lebat awal pagi semalam.
– Gambar FAUZI BAHARUDIN
Oleh FAUZIAH AROF dan ZAINI BABAN


Chaos as flash floods hit city
By Fadhal A. Ghani and Alang Bendahara
news@nst.com.my
KUALA LUMPUR: Sungai Gombak overflowed its banks causing chaos that had not been seen in more than three decades in the heart of the city yesterday evening.
Areas which were hit for the first time included the basement car park of the Putra World Trade Centre and large
ings were also affected by flash floods.
Azizan added that the Sentul Fire and Rescue Department station which is situated just across PWTC was also hit by floods.
At Jalan Ipoh, which rarely sees flash floods, water levels were recorded at between one and two metres high, completely submerging vehicles.
To add to the city folks' woes, RapidKL's Kelana Jaya line


Banjir terburuk
HAMPIR 80 peratus kawasan di Alor Seta
ditenggelami air manakala lebih 40,000
penduduk dipindahkan semalam


Stranded
Wat-er mess: Cars parked behind the PWTC in Kuala Lumpur submerged in muddy flood waters after a downpour yesterday evening. — AHMAD ASMADI

IMPERVIOUS AREAS



FLOODPLAINS

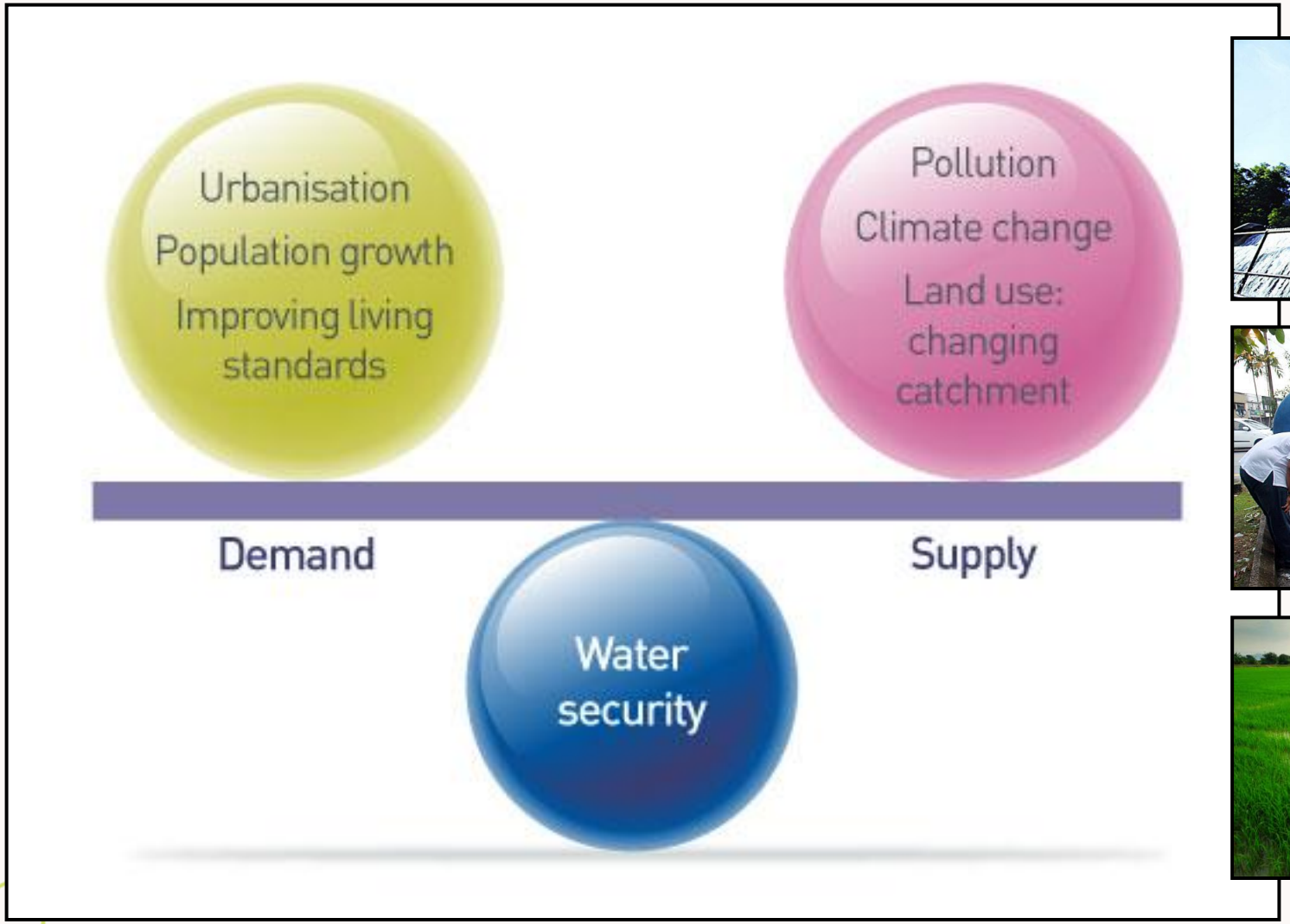
IMPERVIOUS AREAS

Urban Environmental Challenges

COLOURS OF STORMWATER

WHY IUWM?

Why IUWM?


Urbanisation
Population growth
Improving living standards
Pollution
Climate change
Land use: changing catchment
Demand
Supply
Water security

Why IUWM?

Water Infrastructure

Water Demand Management

Alternative Water Resources

Disaster Management

Water Pollution

Governance

- Changing impact of urban development on the natural water cycle.
- Coordination and planning of urban water sector for equitable share to all users.
- Closing the water cycle loop to achieve sufficient water for all to derive maximum benefits.

Urban Waters – Conventional Scenarios

- Single path water supply system (source – user – discharge).
- Water supply, wastewater and stormwater systems: physically distinct.
- Stormwater conveyed away from urban areas.
- Favors structural & centralized approaches to sewage and water supply systems.
- High water standards needed regardless of end user needs.
- Lack of public participation in decision-making.

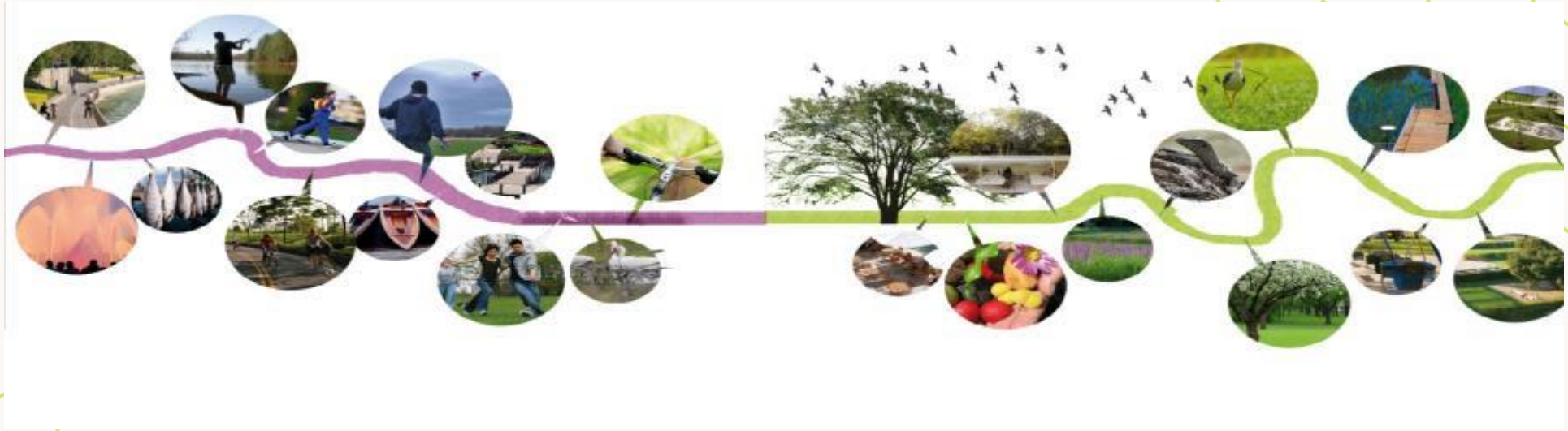
Urban Waters – Changing (IUWM) Scenarios

- Reclamation and reuse of water.
- Stormwater and wastes as resources.
- Integrated systems for water, energy and resource recovery.
- Water quality to match end-user needs.
- Green infrastructure, non-structural measures and de-centralized systems.
- Innovative technology to optimize efficiency and adaptation.
- Inter-agency and public cooperation in decision-making.

HOW IUWM CAN BE ACHIEVED?

How IUWM can be achieved?

- There is no magic solution or single correct way to go about achieving the right degree or level of integration, nor is there one specific institutional model that is applicable to all cases.
- What is required is a change in how individuals and agencies think about their water-related activities.
- Often, strong political will and leadership are needed to get all players on board and move the process forward.



How IUWM can be achieved?

Water Sensitive Cities:

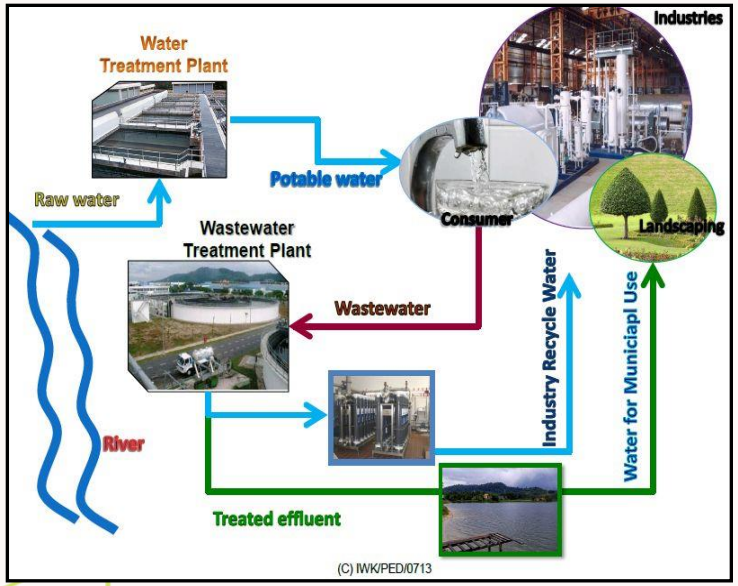
- Resilient, livable, productive and sustainable with water security for economic prosperity through efficient use of the diversity of water resources;
- Healthy urban watercourses;
- Low flood risk and damage;
- Public spaces to harvest clean and recycle water;
- Biodiversity, carbon sequestration possible; reduction of urban heat island effects.

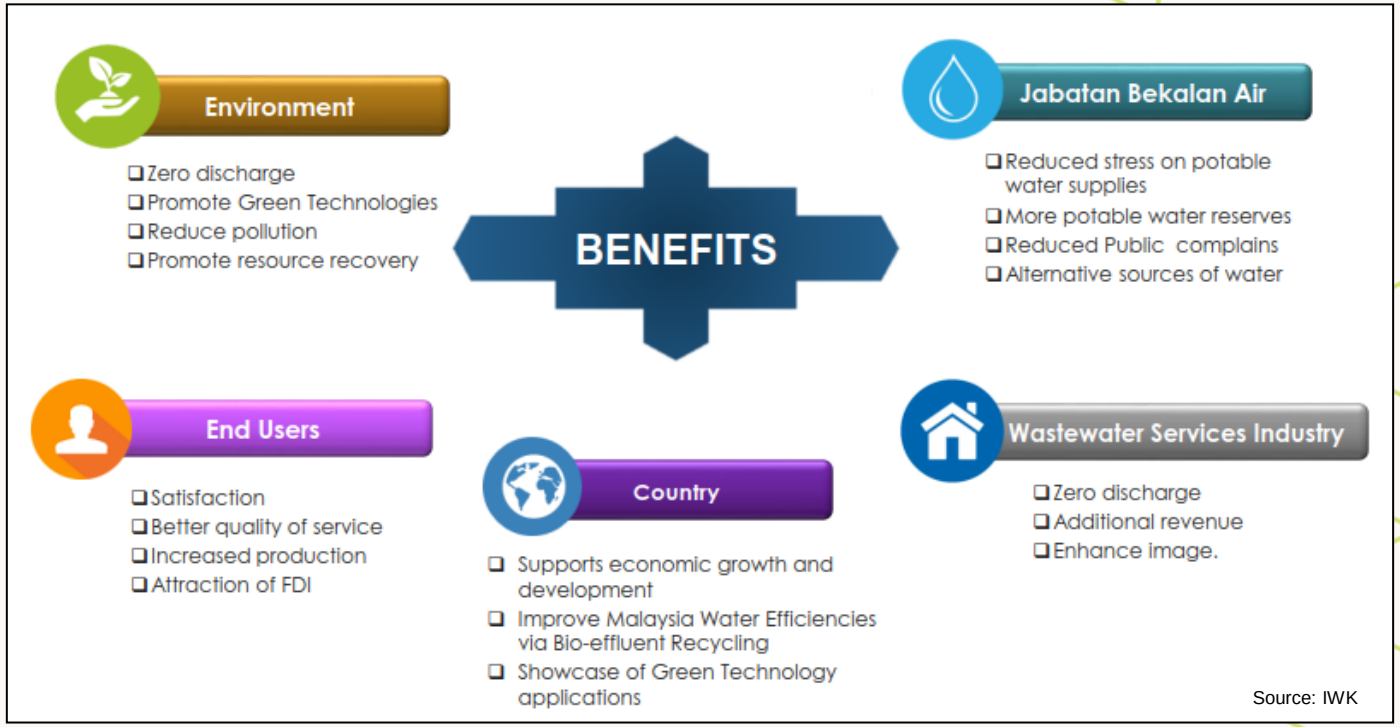
Principles:

- Cities as Water Supply Catchments: Access to water through a diversity of sources at a diversity of supply scales.
- Cities Providing Ecosystem Services: Built-environment functions to supplement and support the function of the natural environment.
- Cities Comprising Water Sensitive Communities: Socio-economic sustainability with public participation.

Strategy 1: Wastewater Recycling/Reuse

- Recycled water is water recovered by treatment of wastewater, greywater or stormwater runoff to a quality suitable for beneficial use.
- One of the greatest potentials for water reuse in the urban areas of Peninsular Malaysia is to reduce, supplement or replace the potable water demands of industries. Among the major uses in the industry are cooling system make up water, boiler feedwater, process water, site irrigation, fire protection, municipal use for cleaning purposes and others.





Strategy 1: Wastewater Recycling/Reuse

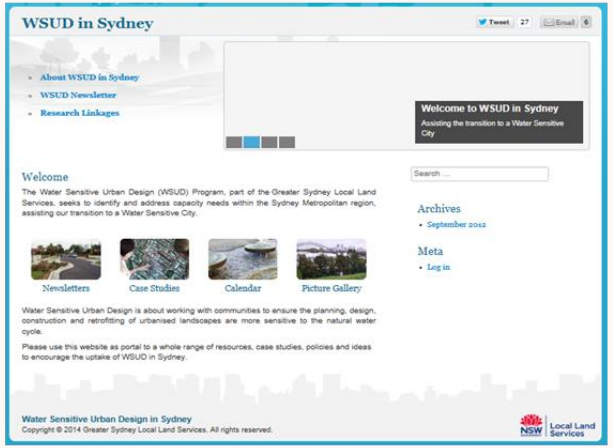
- Full cost recovery (depending on ability to pay) is a desirable objective when comparing water prices for recycled water and treated water supplied for industrial use. Further, cost-benefit analysis of water reuse projects must include other socio-environmental criteria, based on a holistic approach and catchment scale.
- Tariff chargeable for the supply of membrane treated recycled water has been worked out to be RM2.85 per m3 of water supplied (Final Report for Feasibility Study to Develop Water Recycling Plant Utilizing Effluent from STP in Peninsular Malaysia, May 2012, KeTTHA). This is slightly higher than the highest rate charged to industrial consumers in the country which is RM2.70 per m3 (assuming a consumption of 50 m3) in Johor.

Strategy 2: Water Sensitive Urban Design

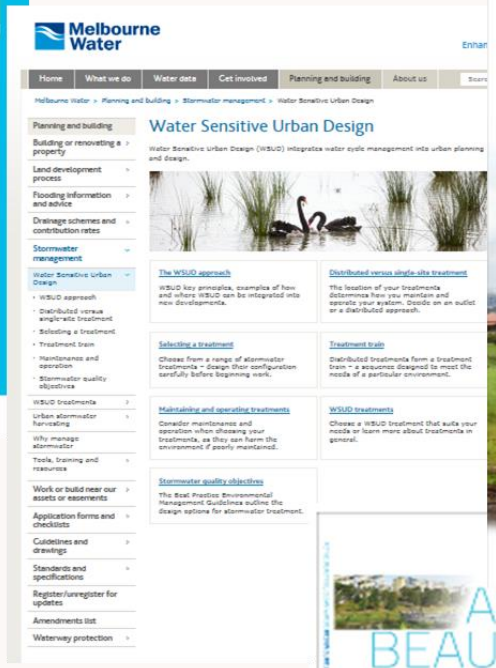
- Water Sensitive Urban Design (WSUD) is the process of integrating water cycle management with the built environment through planning and urban design.
- Water Sensitive Urban Design is the process. Water sensitive places are the outcome. WSUD can be applied at all scales...WSUD is an opportunity to create beautiful, successful and resilient places.

Strategy 2: Water Sensitive Urban Design

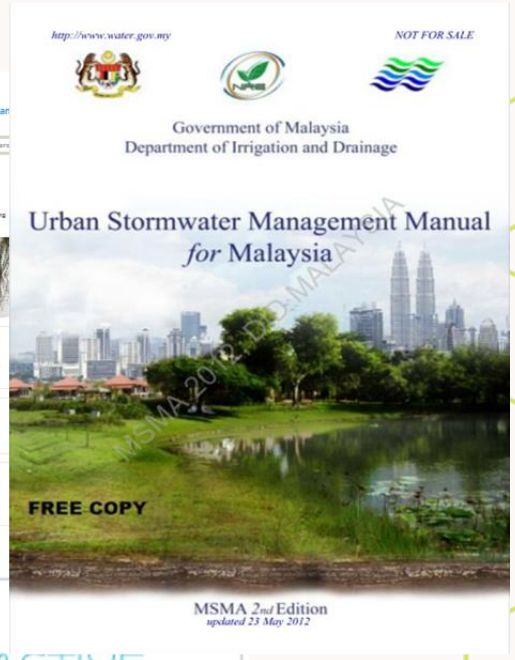
Source: CIRIA



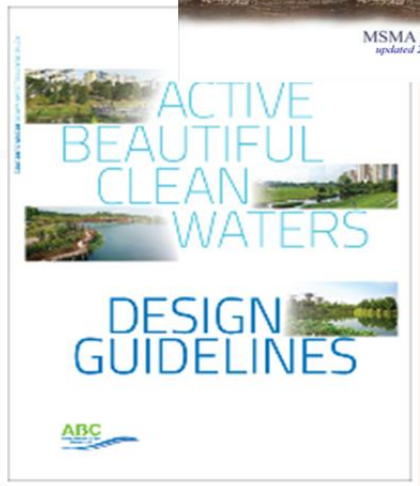
Source: Sydney Water



Source: Melbourne Water



Source: JPS



Source: PUB

Strategy 2: Water Sensitive Urban Design

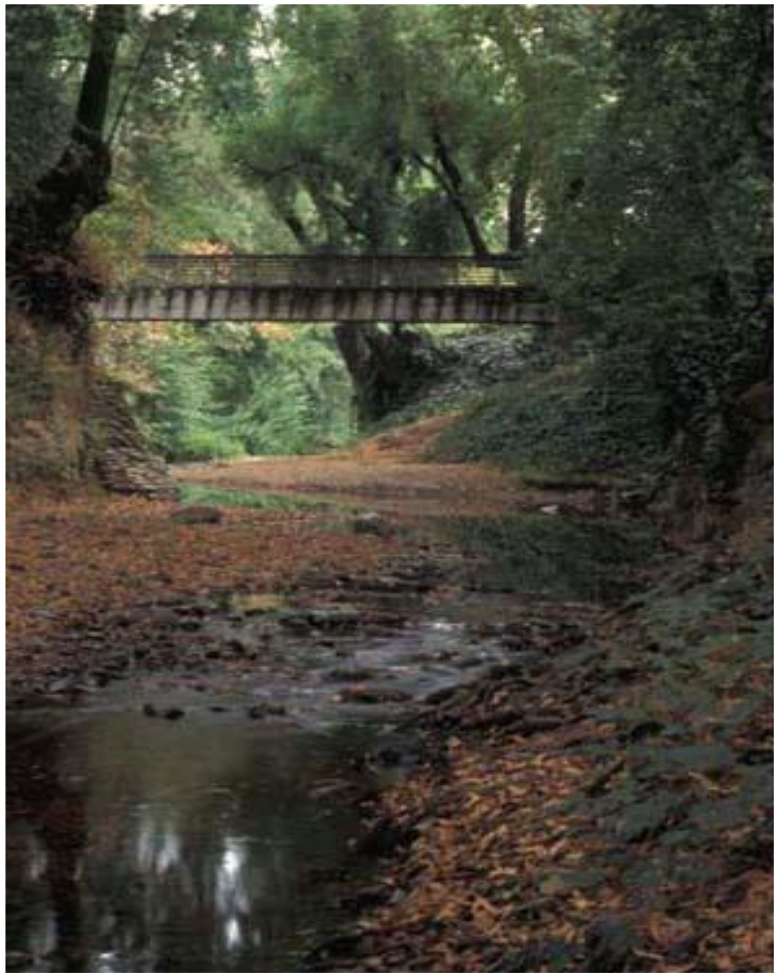
SUSTAINABLE URBAN SYSTEM???

Which is cheaper to build?

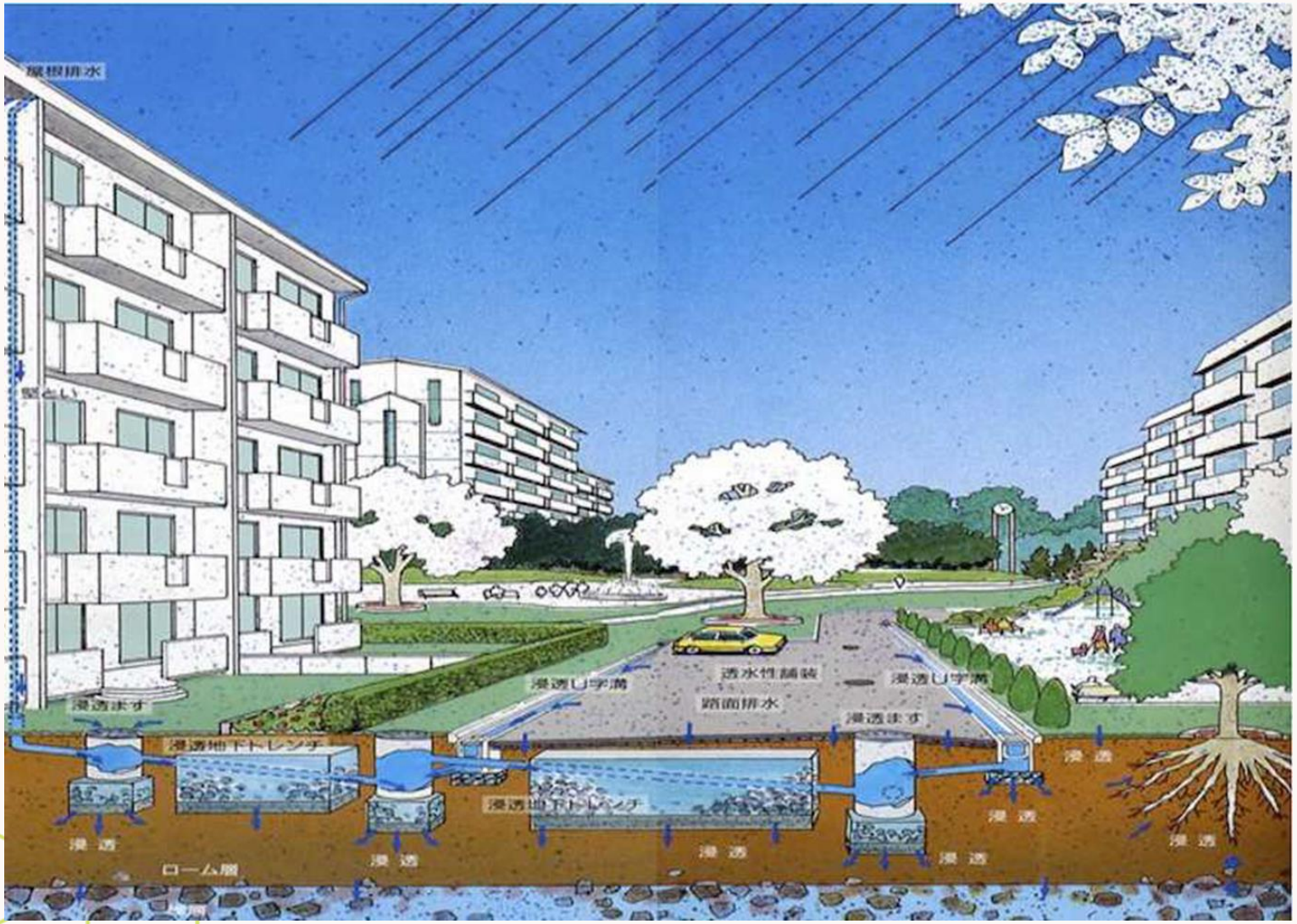
Which is easier to maintain?

Which of these is preferable?

Why?

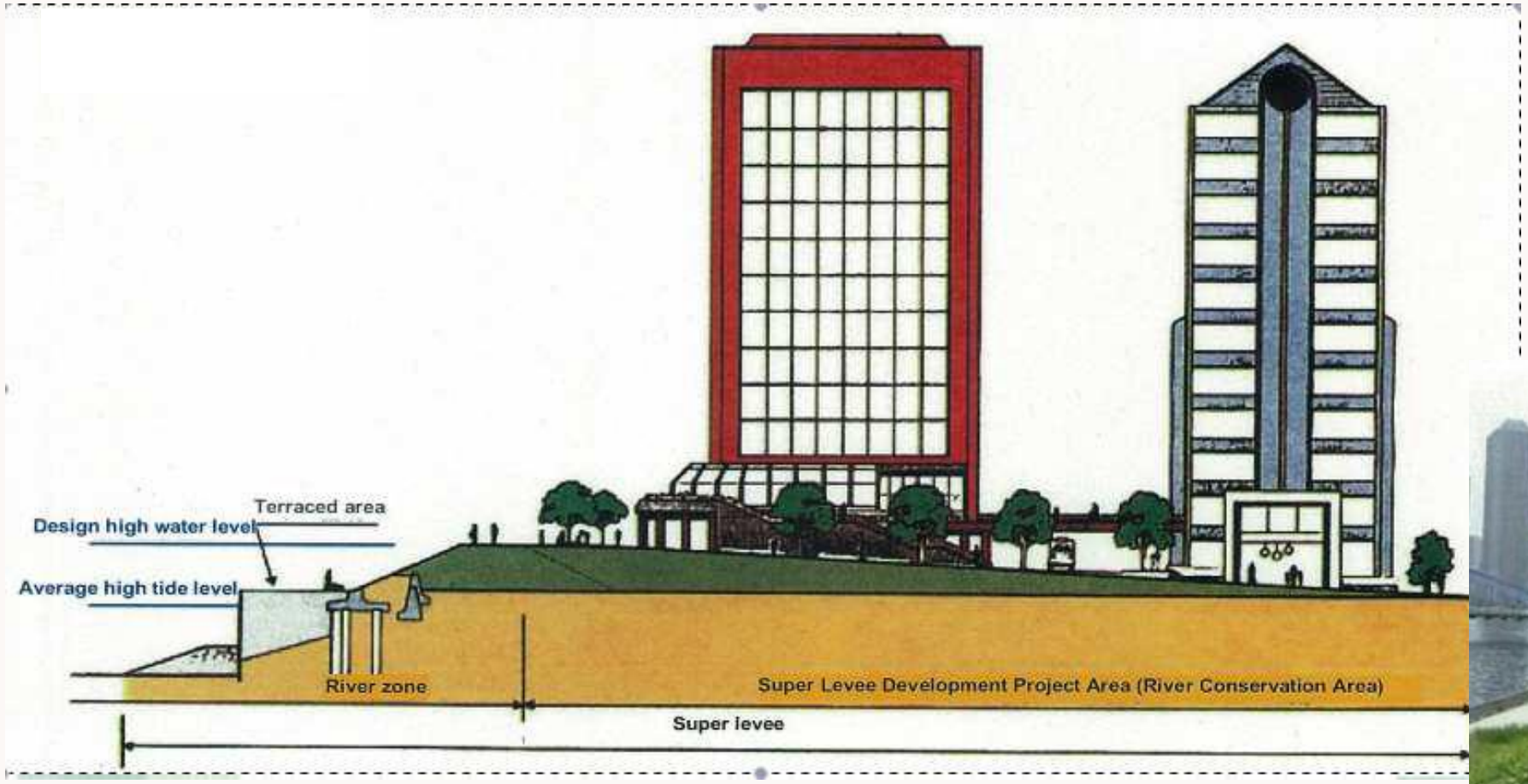


Strategy 2: Water Sensitive Urban Design



SUSTAINABLE URBAN DRAINAGE SYSTEM

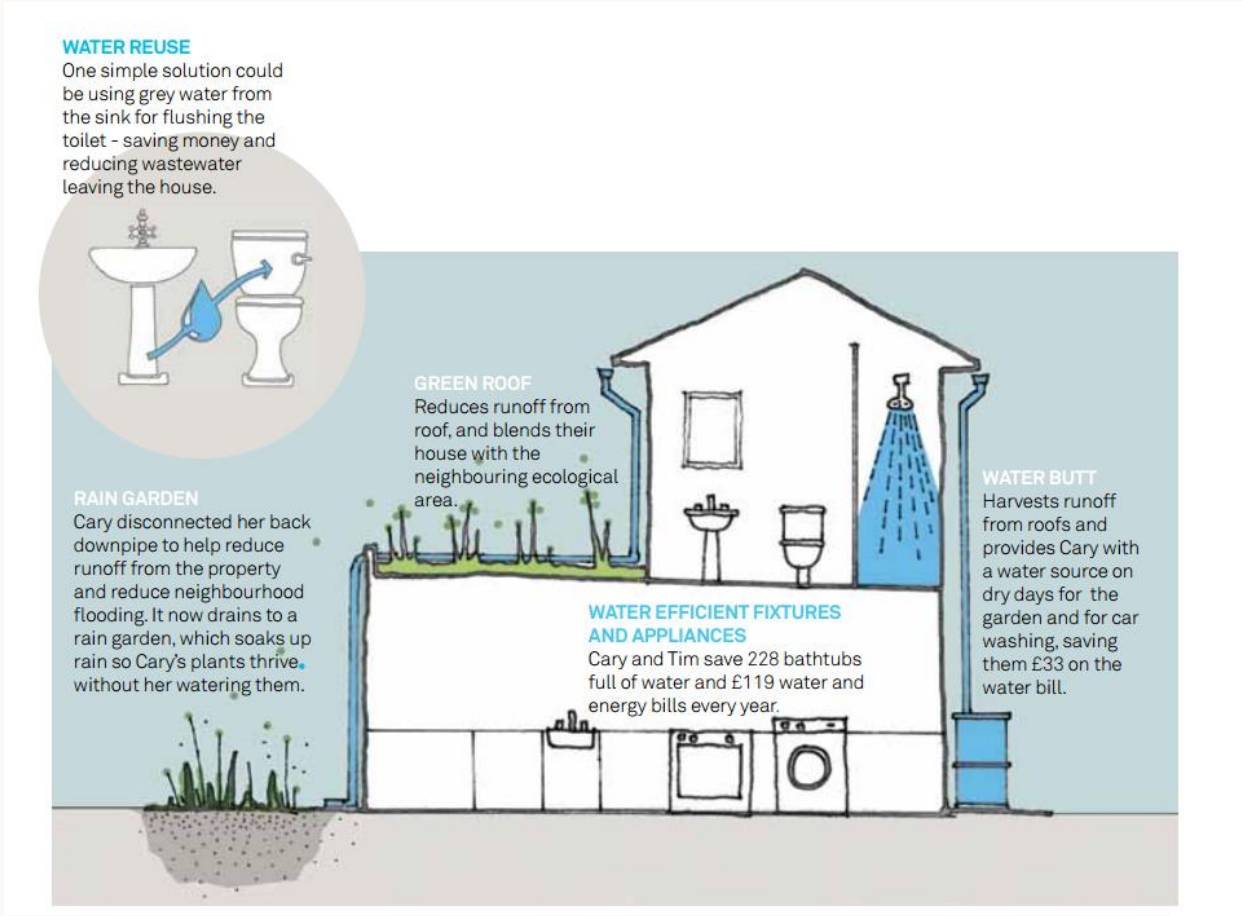
Strategy 2: Water Sensitive Urban Design

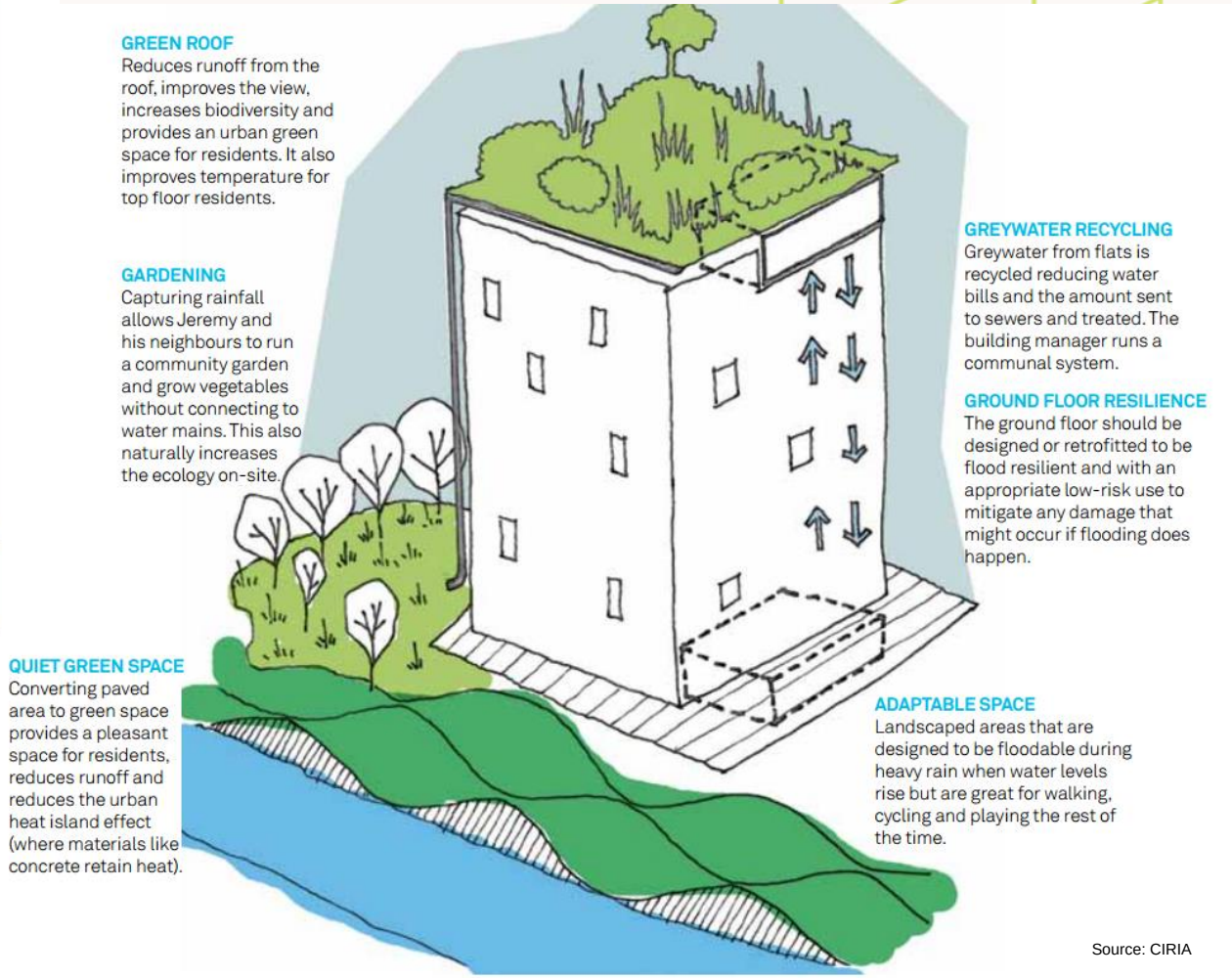


Strategy 2: Water Sensitive Urban Design

SUSTAINABLE URBAN DRAINAGE SYSTEM

Strategy 2: Water Sensitive Urban Design



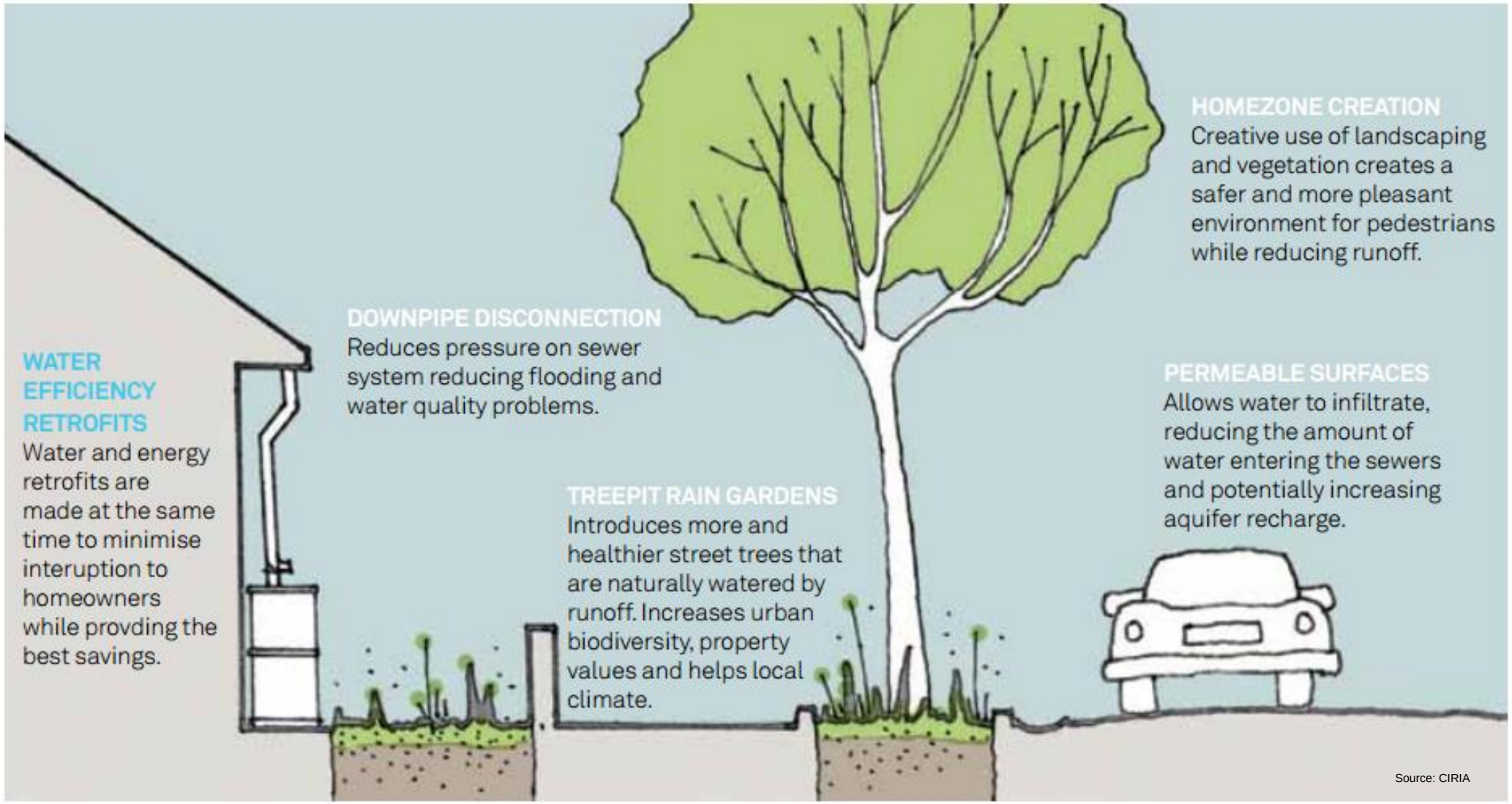


Source: CIRIA

Strategy 3: Rainwater Harvesting

- Stormwater could be considered as a valuable resource and not as a waste problem or a threat. In the planning process, it can reduce the cost of climate adaptation and give greater benefits to urban and as well as rural areas and people's lives
- Use of water from rainwater harvesting constitutes high potential of usage permitting lesser water quality. It can be harvested for recreational purposes that also provide environmental and economic benefits.

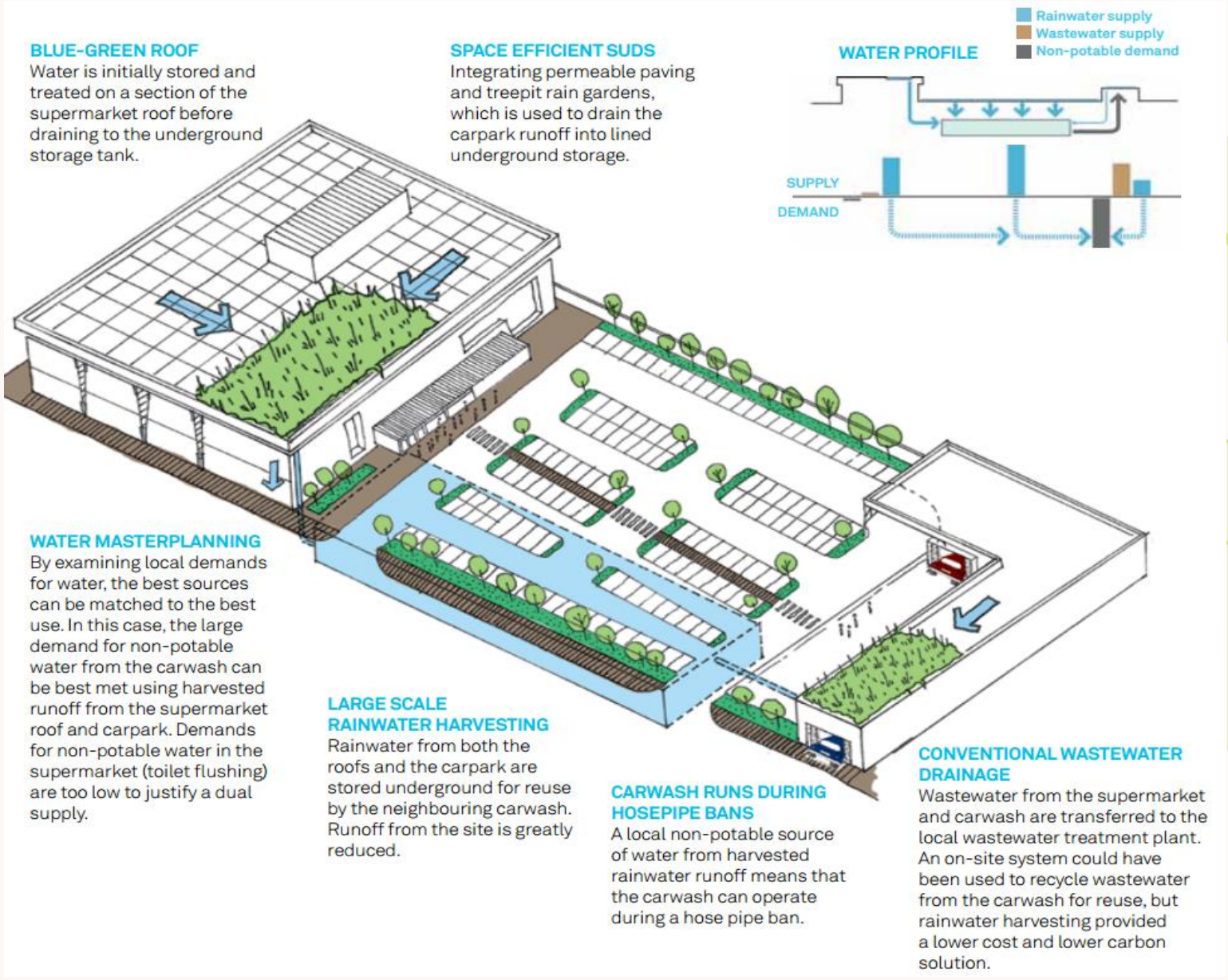
Strategy 3: Rainwater Harvesting



Strategy 3: Rainwater Harvesting

- In Malaysia, rainwater harvesting programme has been implemented for new housing developments and government buildings. Uniform Building By-laws (Amendment) 2012 provide for Rainwater Harvesting and Utilisation System to be installed only for bungalows and semi-detached houses with a roof area equivalent to or more than 100 m2.
- The 1 Utama New Wing building in Petaling Jaya, Selangor which has roof spreading over 30,000 m2 collects adequate rainwater storage for 10 days for usage of the shopping centre. The harvested rainwater usage is restricted for toilets flushing, air conditioning cooling towers, car park washing and landscape irrigation. Bandar Utama had reported a 30% savings on water demand for the 1 Utama New Wing Building (The Ingenieur, June – August, 2010).

Strategy 3: Rainwater Harvesting



Strategy 4: Water Efficient Products

– Such products include water efficient water closets, showers, dishwashers, washing machines and efficient use of taps and restrictor valves. Efficiency labelling schemes are introduced to encourage manufacturers to produce efficient products which are recommended for use by consumers and users of water.


Water saving tap aerator


Dual flush toilet

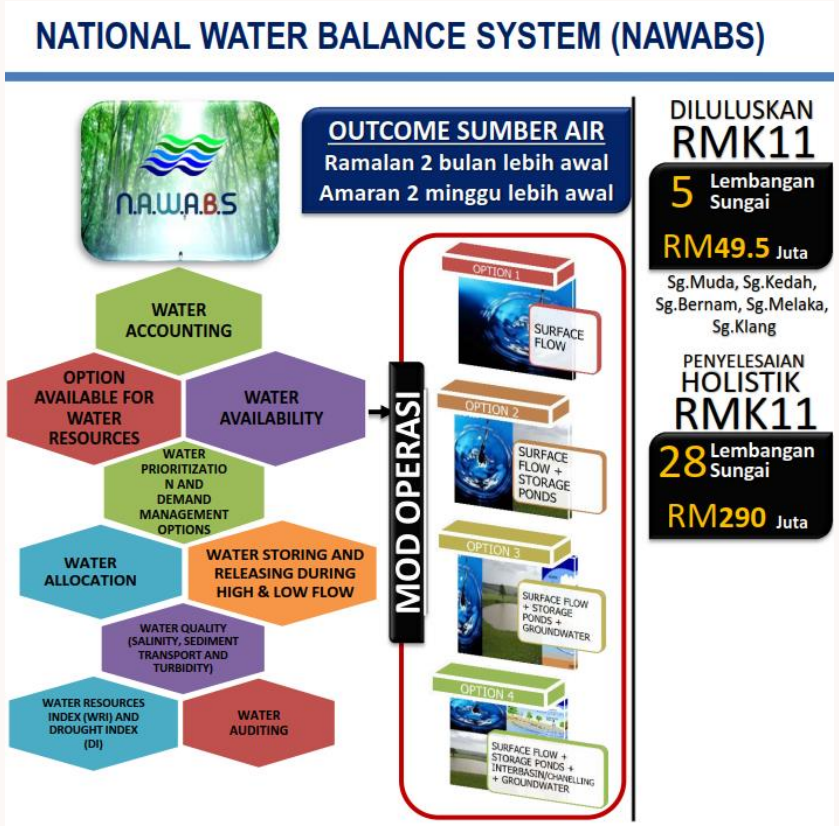
Water Efficiency Labelling and Standards (WELS) Scheme, Australia

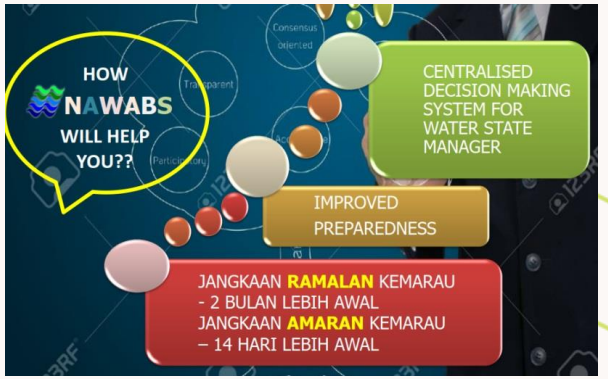
Strategy 4: Water Efficient Products

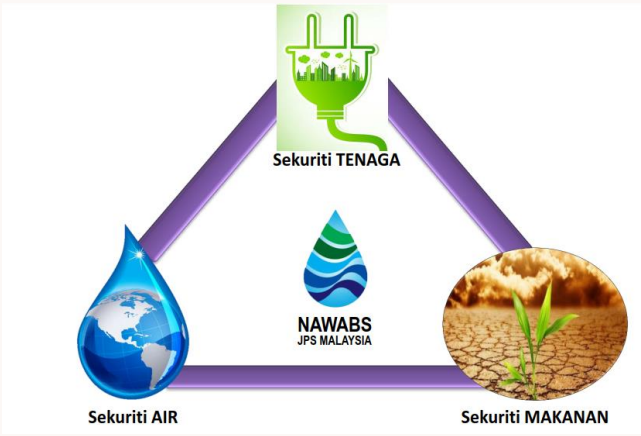
- SPAN has enforced the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 starting 1 February 2014 with the use of dual flush toilets (full flush volume is 6 litres and half flush volume is 3 litres). This is mandatory for new development projects and renovated buildings. Furthermore, the use of urinal which has a flush volume of not exceeding 2.5 litres for each compartment has also been proposed.
- SPAN's Skim Pelabelan Produk Cekap Air (SPPCA) Implementation Guidelines was launched in January 2013 for water closet, urinals, tap (basin, sinks and showers). At the end of 2013, two more closets were added which are washing machine and showerhead. The products are assessed based on usage efficiency for which star ratings are given. The number of stars reflects more efficient use of water.

Strategy 5: Technology

– Decision Management System Tools such as National Water Balance System (NAWABS) for planning of water allocation and to assist state water managers to forecast and prepare a mitigation plan to counter prolonged dry spells.



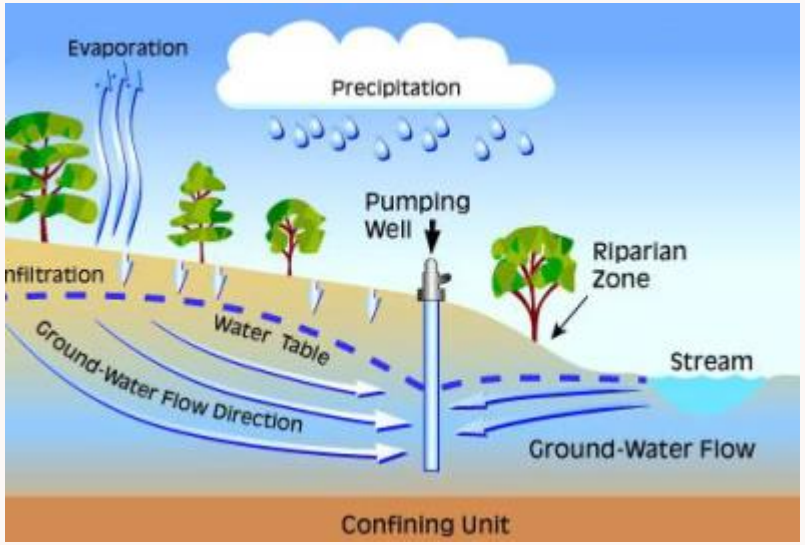




Strategy 6: Alternative Water Sources

- A number of alternative water collection systems have been tested and used in Malaysia. This includes the Hybrid Off-River Storage (HORAS) in Selangor, Horizontal Collect Well (HCW) in Kelantan and Riverbank Filtration System (RFS) in Perak. These systems have successfully been used as alternative source of water during times of prolonged dry spell.
- The Review of National Water Resources Study (DID, 2012) also suggest the potential groundwater reserves in several states in Malaysia which has potential as alternative water source. DID estimates that RM 231 million is required for investigation works in 33 riverbasins and approximately RM 1,245 million for CAPEX for infrastructure development to tap this resource.
- Cloud seeding is a weather modification technique that involves the introduction of seeding agent into suitable clouds to encourage the formation and growth of raindrops and stimulate the precipitation process. Cloud seeding is done using light aircrafts such as the Cessna or military aircrafts such as the TUDM C-130.

Strategy 6: Alternative Water Sources



Source: AF Jets

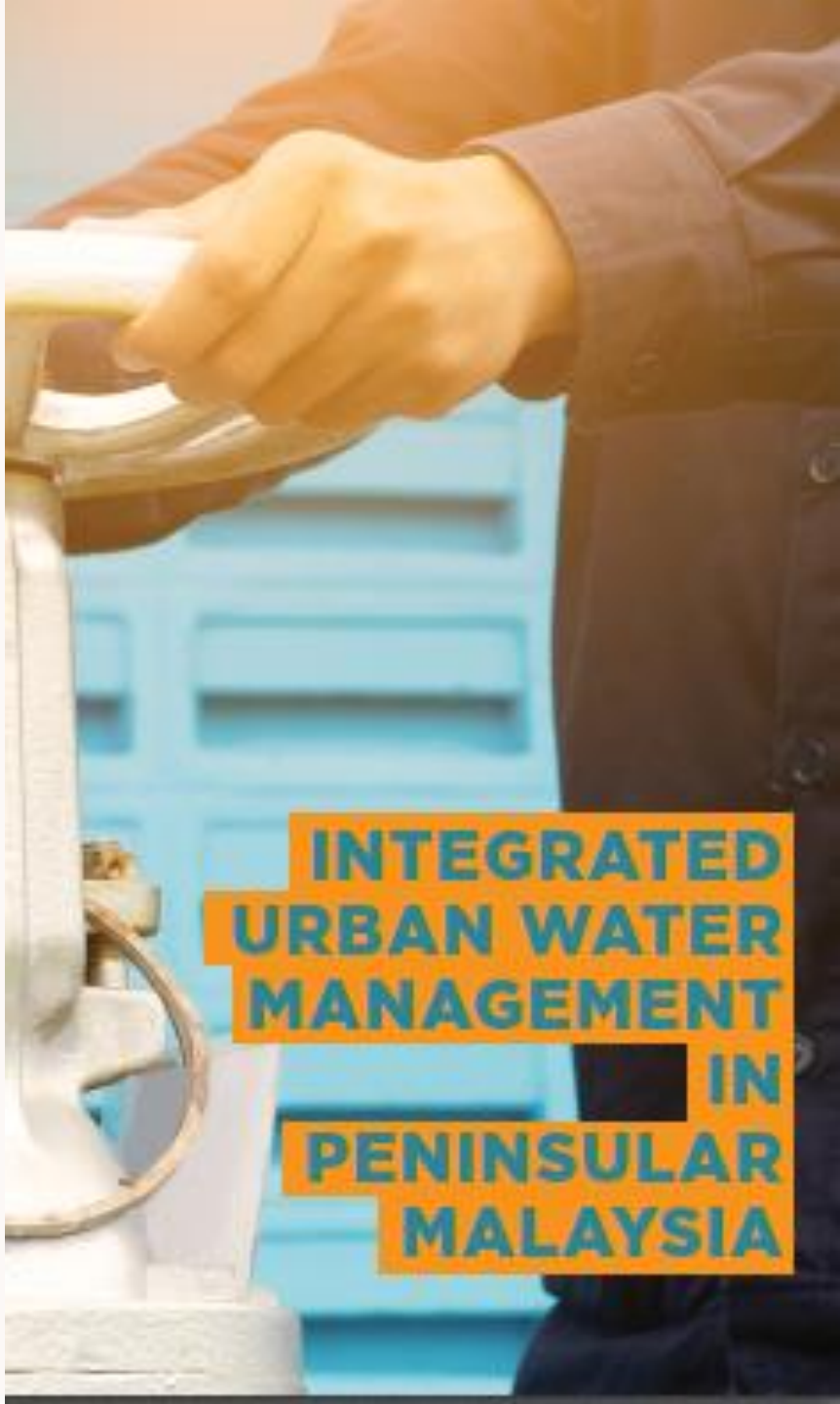
Coastal Reservoir

Source: PUB

STUDY BY ASM

IUWM in Peninsular Malaysia Study by ASM

- The Academy of Sciences Malaysia (ASM) has since 2008 been undertaking studies pertaining to the water sector considered strategic for the country's socio-economic development. The studies have been overseen by a dedicated ASM Water Committee.
- One of the task forces mandated by the ASM Water Committee on Sustainable Water Management (SWM) Programme was the Integrated Urban Water Management (IUWM) in 2015 chaired by Dr Low Kwai Sim FASc to conceive a pragmatic IUWM system for cities and urban areas in the country.
- The position paper on Integrated Urban Water Management (IUWM) in Peninsular Malaysia was completed in 2018.



INTEGRATED URBAN WATER MANAGEMENT (IUWM) IN PENINSULAR MALAYSIA

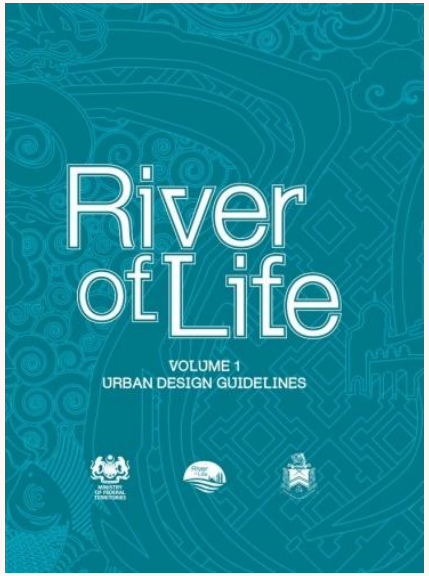
Categories of publication

- All Publications (76)
- Advisory Report (54)
  - Science Outlook 2015 (2)
  - Science Outlook 2017 (2)
  - NEO (New Economic Opportunities) (1)
  - Sustaining Malaysia's Future – The Mega Science Agenda (5)
  - Mega Science 2.0 (5)
  - Mega Science 3.0 (5)
- Position Paper (7)
- Monograph (3)

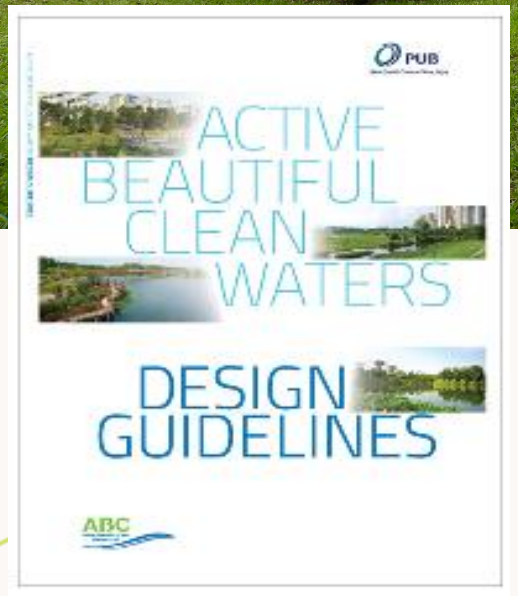
Published on 27/06/2019

EXAMPLE OF IUWM AND SUSTAINABLE CITIES

River of Life – Kuala Lumpur, Malaysia



Active Beautiful Clean - Singapore



Active Beautiful Clean – Singapore

Sg. Api-Api and Sg Tampines

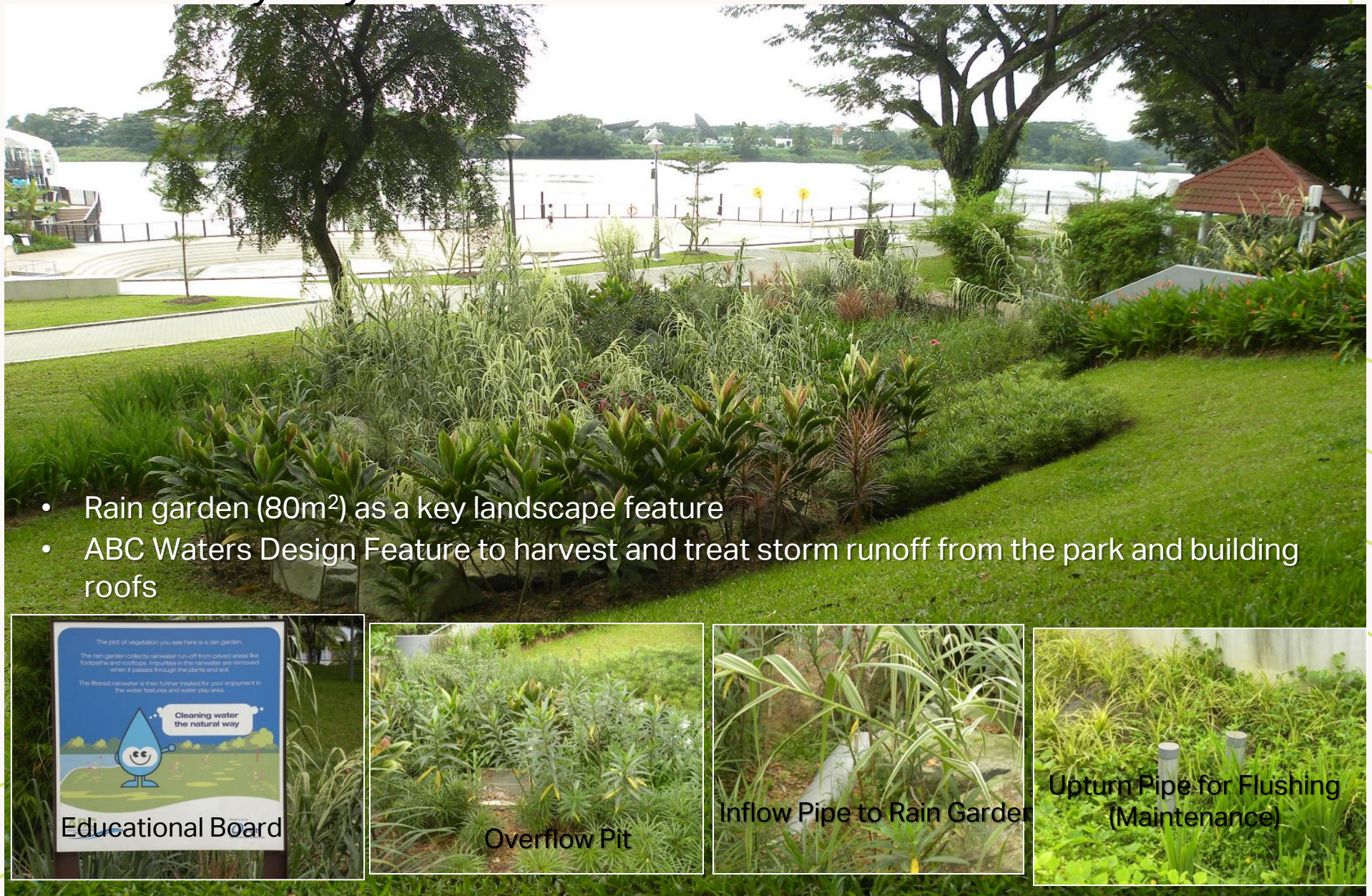
Linear Rain Garden along Footpath

Cleansing Biotope to treat dry weather flow and first flush of storm runoff

Rain Garden Integrated into Community Space

Active Beautiful Clean – Singapore

Lower Seletar Family Bay: Rain Garden/Bio-retention



- Rain garden (80m^2) as a key landscape feature
- ABC Waters Design Feature to harvest and treat storm runoff from the park and building roofs

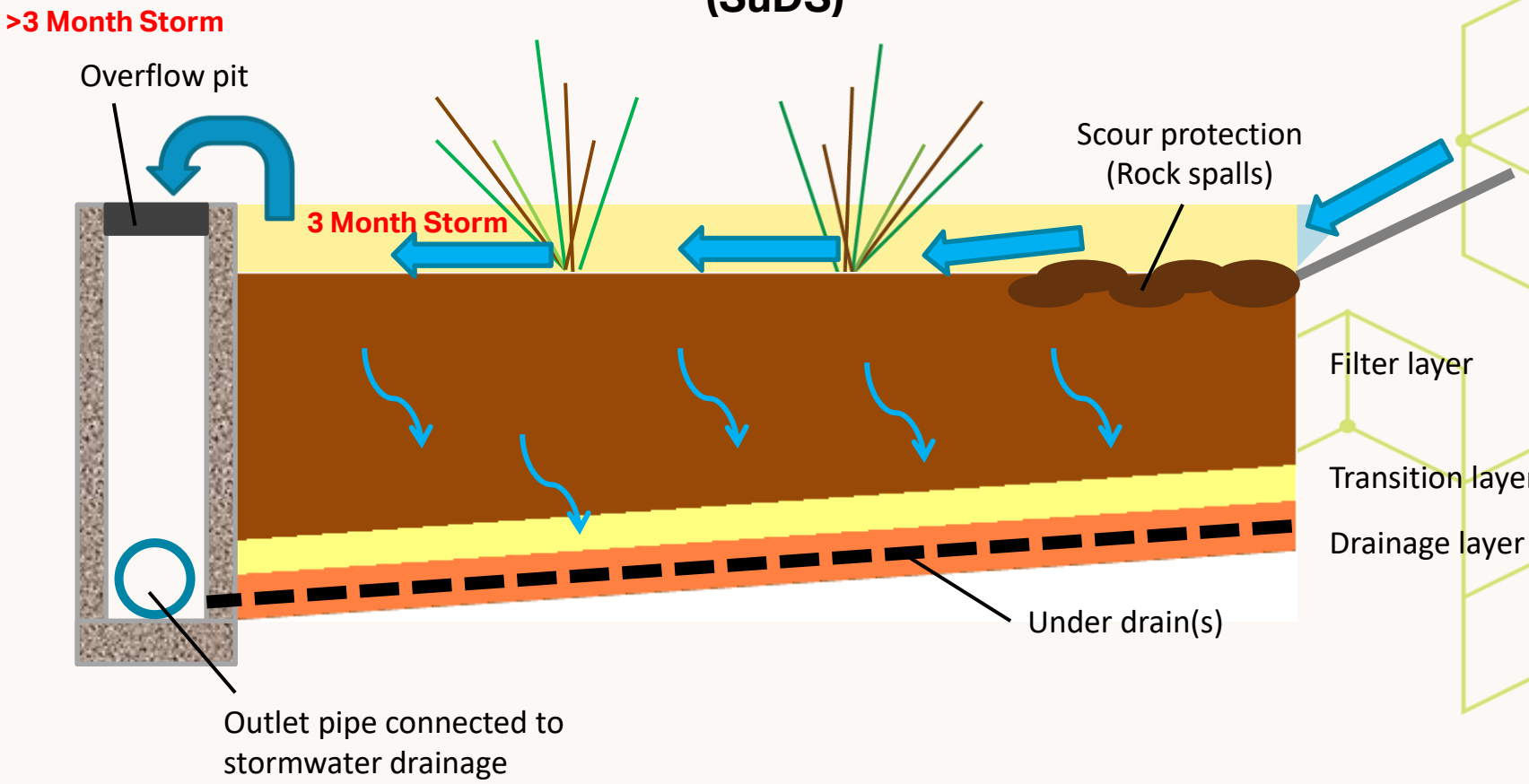
Educational Board

Overflow Pit

Inflow Pipe to Rain Garden

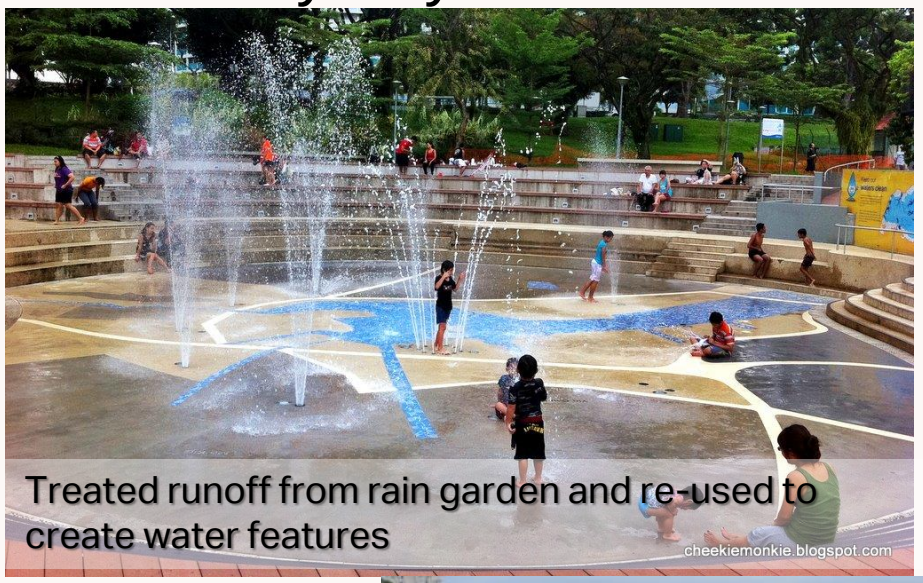
Upturn Pipe for Flushing (Maintenance)

Working Principle of Rain Garden – a form of Sustainable Urban Drainage System (SuDS)



Active Beautiful Clean – Singapore

Lower Seletar Family Bay: Rain Garden/Bio-retention



Treated runoff from rain garden and re-used to create water features

Treated runoff re-used to create water stage for Water Puppet Show

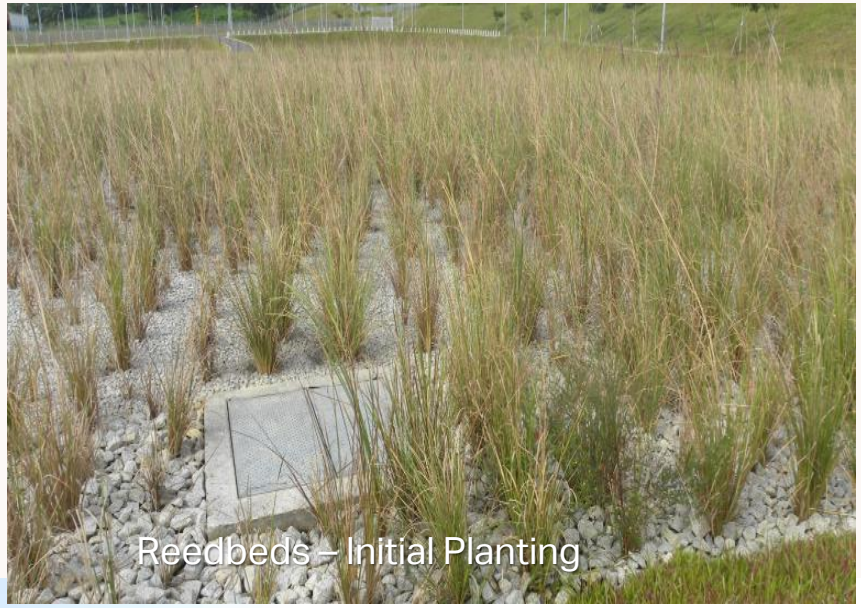
Treated runoff from rain garden and re-used to create Wading Pool & Children's Stream

Active Beautiful Clean – Singapore

Lorong Halus Wetland

Active Beautiful Clean – Singapore

Lorong Halus Wetland



Reedbeds – Initial Planting

Reedbeds – More Established

Active Beautiful Clean – Singapore

Lorong Halus Wetland


Polishing Pond


Bell mouth outflow control


Polishing Pond

Active Beautiful Clean – Singapore

Lorong Halus Wetland

Educational Kiosk – Day Time

Educational Kiosk – Evening Time

Active Beautiful Clean – Singapore

Gardens By The Bay

Active Beautiful Clean – Singapore

Marina East Gardens

Active Beautiful Clean – Singapore

Sg. Ulu Pandan & Pandan

Active Beautiful Clean – Singapore

Sg. Ulu Pandan & Pandan

Softening of canal with washed pebbles and geo-walls

Active Beautiful Clean – Singapore

Sg. Ulu Pandan & Pandan

Sedimentation Basin

Active Beautiful Clean – Singapore

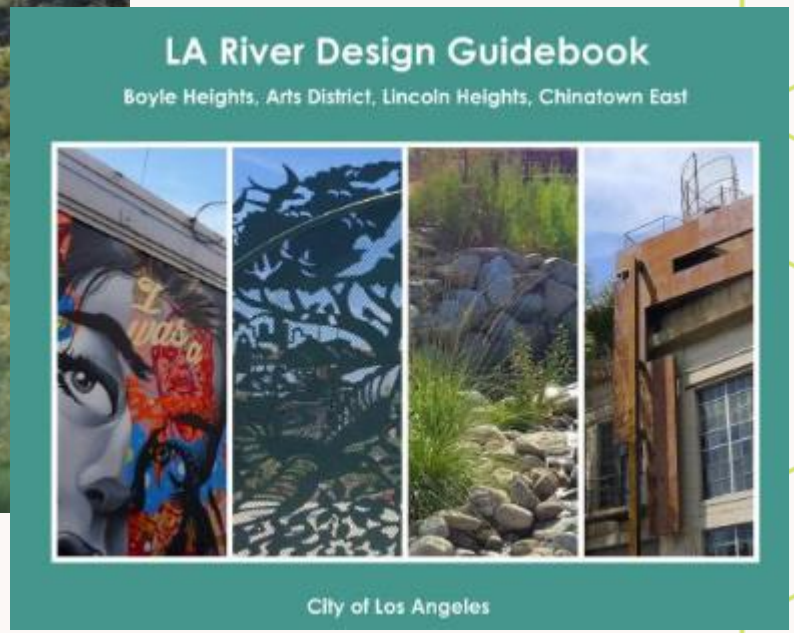
Sg. Ulu Pandan & Pandan

Active Beautiful Clean – Singapore

Sg. Ulu Pandan & Pandan

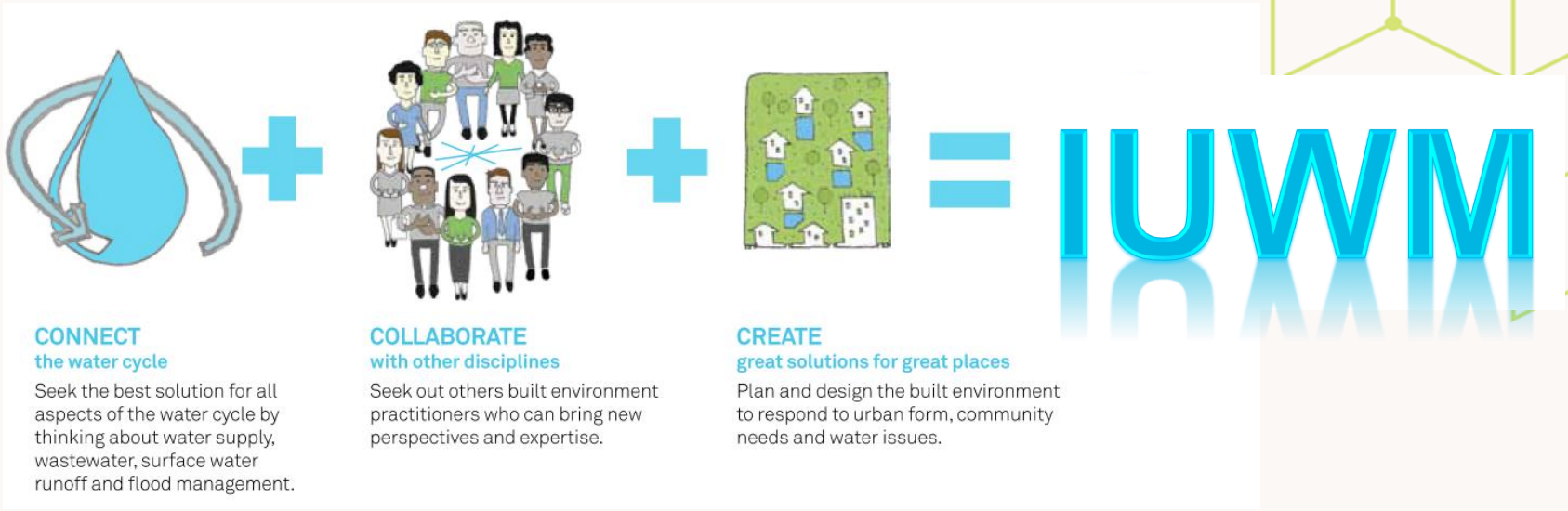
Viewing deck over vegetated swale

LA River Revitalization – Los Angeles, USA



Conclusion

- The presentation has put forth IUWM strategies for consideration and adoption to achieve sustainable cities.
- IUWM needs to be applied and implemented in an integrated way by the people and partners that plan and design the built environment.
- In doing so, we can bring together the skills and creativity of practitioners who plan and design the places we live in to bring much wider benefits to communities and revive our urban water sources.



Acknowledgement

– Academy of Sciences Malaysia
– AECOM
– Dr Stephen Tan
– CIRIA UK
– JPS Malaysia
– PUB Singapore
– PPSP Melaka, Malaysia
– iCONSERVE Pennsylvania, USA
– CapNet UNDP
– US EPA
– ICLEI European Secretariat GmbH
– Others quoted on this Presentation

Organised by

malaysiaGBC

Established Member of

WORLD GREEN BUILDING COUNCIL

SUSTAINABLE DEVELOPMENT GOALS

NATURAL RESOURCES:

WATER EFFICIENCY FOR SUSTAINABLE LIVING

13 AUGUST 2022 | VIRTUAL VIA ZOOM

Any Questions?

Ir. C Kamalesen, PEPC, FIEM, ACPE, APEC Engineer, ASEAN Engineer, IntPE
kamalesen@gmail.com
012-3050540